065
Proponent Revision
~~Received 6/01/22~~
Received 6/07/22

STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

Code being amended: ☐ Commercial Provisions ☒ Residential Provisions

Code Section # R403.13, R405.2, R503.1.2

Brief Description:

This code proposal would require new residential buildings to install heat pump space heaters for space conditioning.

Purpose of code change:

Requiring space heating to be all-electric eliminates a significant source of fossil fuel combustion in buildings, and is generally 2-4x more energy efficient than either fossil fuel or electric resistance heating. This proposal aligns with State policy to increase energy efficiency by 70% by 2031. Additionally, this proposal will significantly reduce emissions and is aligned with State policy to achieve the broader goal of building zero fossil-fuel greenhouse gas emission homes and buildings by the year 2031. According to analysis done using data from the 2021 Washington State Energy Strategy, we need to reduce the commercial buildings sector emissions by 44% to keep on track to meet our 2050 climate goals. To achieve this, the State will need to double the proportion of annual sales of heat pumps from 21% of all residential space heating equipment in 2020 to 39% by 2030. To get to this increase in market penetration of heat pumps, the Washington State Energy Code should require all residential space heating to be all-electric in the 2021 code cycle. See Supplemental Attachment for further details on economics, emissions reduction and market penetration.

What the proposal does:

The proposal requires that space heating be provided by heat pump equipment. It includes key exceptions to foster flexibility, usability and enforceability:

- It allows up to 1000W of resistance heating per dwelling unit. This allows for spot heating applications (such as heated floors in a bathroom) and for very well-insulated homes with very small heating loads (such as those built to the PHIUS standard) to be served by inexpensive systems.
- It is explicit that the resistance heating elements that are integrated into unitary heat pumps - such as crankcase heaters - solar thermal systems and waste heat and energy recovery systems are not impacted by this new language
- It allows supplementary heat in accordance with WSEC's supplementary heat control requirements that already address this system configuration

The proposal then has language in section R503 to ensure that these requirements would not apply to simple equipment replacements. The exception is configured so that it is only available when new equipment is the same size as the equipment being replaced. This ensures that the heat pump requirements will not trigger an electrification retrofit for equipment replacement unless it is a major system reconfiguration with a larger piece of equipment.

This proposal does not impact larger, more complex systems that serve multiple dwelling units since those systems are already referred to the commercial section of the code by R403.8.

Reason for revisions

We met with several interested parties who expressed concerns with the proposal. We addressed as many of those concerns as possible by making the following edits to the proposal:

- There was a concern that buildings with very low heating demand like those built to the Passive House standards would be required to install oversized heat pump equipment that would not run very often and justify the additional expense. The proposal was updated to allow up to 1.1Wsf in CZ4 and 1.3W/sf of electric resistance for those types of buildings.
- It was noted that this proposal made R403.7.1 redundant, therefore the section and entry from Table R406.2 were eliminated.
- There was a concern that the proposal completely eliminated natural gas options, particularly in light of the increasing availability of natural gas heat pumps. As the proposal is focused primarily on efficiency, it was revised so that either an electric or gas heat pump can be used to meet the requirement. This revision also made it unnecessary to modify the fuel normalization table.
- There was a concern that the "other systems as approved" was too broad, so it was eliminated.

Your amendment must meet one of the following criteria. Select at least one:

☐ Addresses a critical life/safety need.

☐ The amendment clarifies the intent or application of the code.

☒ Addresses a specific state policy or statute.
(Note that energy conservation is a state policy)

☐ Consistency with state or federal regulations.

☐ Addresses a unique character of the state.

☐ Corrects errors and omissions.

Check the building types that would be impacted by your code change:

☒ Single family/duplex/townhome	☐ Multi-family 4 + stories	☐ Institutional
☒ Multi-family 1 – 3 stories	☐ Commercial / Retail	☐ Industrial

Your name	Sean Denniston	Email address	sean@newbuildings.org
Your organization	NBI	Phone number	503-481-7253
Other contact name	Click here to enter text.		

Economic Impact Data Sheet

Is there an economic impact: ☒ Yes ☐ No

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants, and businesses. If you answered "No" above, explain your reasoning.

Construction costs for heat pump space heaters are often, but not always, higher than for conventional natural gas or electric resistance space heaters. When eliminating the cost of gas infrastructure running to the building and the cost of a separate air conditioner for space cooling, all-electric homes are generally less expensive than mixed fuel homes.

Annual energy costs for heat pump space heaters are much lower than for electric resistance heating, but comparable with gas heating, at current rates (World Bank long term forecasts indicate an increase of over 80% in gas prices over the coming decade.) When including the Washington State social cost of carbon, heat pump space heating is more cost effective than both gas heating and electric resistance heating over the life cycle analysis horizon.

Given the state's climate goals and policy, this Energy Code proposal will help ensure new assets permitted beginning July 1, 2023 will not need to be immediately retrofitted.

Provide your best estimate of the **construction cost** (or cost savings) of your code change proposal? (See OFM Life Cycle Cost **Analysis tool** and **Instructions;** use these **Inputs**. **Webinars on the tool can be found Here and Here**)

Upfront cost savings is $1.14/ sq ft or $2,725 per home.

The life cycle cost savings, not including the social cost of carbon, is $3.41/ sq ft or $8,192 per home.

The life cycle cost savings, including the social cost of carbon, is $4.57/ sq ft or $10,974 per home.

Show calculations here, and list sources for costs/savings, or attach backup data pages

See attached supplemental.

Provide your best estimate of the **annual energy savings** (or additional energy use) for your code change proposal?

Annual energy savings of 5.5 kBTU/ sq ft

Annual energy savings of 13,140 kBTU per home

(For residential projects, also provide Click here to enter text.KWH/KBTU / dwelling unit)

Show calculations here, and list sources for energy savings estimates, or attach backup data pages

List any **code enforcement** time for additional plan review or inspections that your proposal will require, in hours per permit application:

No increase in plan review or inspection time.

Small Business Impact. Describe economic impacts to small businesses:

No impact on small businesses, since this is the residential code.

Housing Affordability. Describe economic impacts on housing affordability:

No impact on housing affordability since this will actually save builders money.

Other. Describe other qualitative cost and benefits to owners, to occupants, to the public, to the environment, and to other stakeholders that have not yet been discussed:

Improve air quality and reduce greenhouse gas emissions.

Supplemental Data:

Life Cycle Cost Analysis				
Alternative	**Mixed-fuel Building (Baseline)**	**All-Electric Building Proposal**	**Heat Pump Water Heating Proposal**	**Heat Pump Space Heating Proposal**
Energy Use Intenstity (kBtu/sq.ft)	24.4	15.0	21.2	18.9
% Energy Reduction	N/A	39%	13%	22%
1st Construction Costs	$16,411	$13,402	$17,057	$13,686
PV of Capital Costs	$34,752	$32,318	$36,563	$28,959
PV of Utility Costs	$32,319	$28,890	$31,182	$29,920
Total Life Cycle Cost (LCC)	**$ 67,071**	**$ 61,208**	**$ 67,745**	**$ 58,879**
Net Present Savings (NPS)	**N/A**	**$ 5,864**	**$ (674)**	**$8,192**
Tons of CO2e over Study Period	108	30	81	64
% CO2e Reduction vs. Baseline	N/A	72%	25%	40%
Present Social Cost of Carbon (SCC)	$ 7,191	$ 2,242	$ 5,502	$ 4,410
Total LCC with SCC	**$ 74,263**	**$ 63,450**	**$ 73,247**	**$ 63,288**
NPS with SCC	**N/A**	**$ 10,813**	**$ 1,016**	**$ 10,974**

Cost Data:

City	Building	Retrofit/NewCon	Appliance Family	Appliance	G/E	Total Costs	Source
Seattle	Single family	New Construction	Gas Connection	new gas connection	Gas Baseline	$2,164	RMI EEB v2
Seattle	Single family	New Construction	Air Conditioner	air conditioner - 2ton	Gas Baseline	$6,536	RMI EEB v2
Seattle	Single family	New Construction	ASHP	multi-zone heat pump HVAC - low capacity	Electric	$8,477	RMI EEB v2
Seattle	Single family	New Construction	Gas Furnace	new gas furnace - 80k BTU	Gas Baseline	$4,666	RMI EEB v2
Seattle	Single family	New Construction	Gas Stove	gas stove 2	Gas Baseline	$1,151	RMI EEB v2
Seattle	Single family	New Construction	Gas Water Heater	gas water heater 1	Gas Baseline	$1,894	RMI Heat Pumps for Hot Water
Seattle	Single family	New Construction	HP Water Heater	heat pump water heater 1	Electric	$3,028	RMI Heat Pumps for Hot Water
Seattle	Single family	New Construction	Induction Stove	induction stove 1	Electric	$2,385	RMI EEB v2

Energy Analysis:

	Site Energy Use (MMBtu/yr)			
End Use	**Mixed-fuel Building**	**All-Electric Building**	**Heat Pump Water Heating***	**Heat Pump Space Heating***
Misc. (E)	9.1	9.1	9.1	9.1
Vent Fan (E)	2	2	2	2
Lg. Appl. (E)	6.5	8.06	6.5	6.5
Lights (E)	6.77	6.77	6.77	6.77
Cooling Fan/Pump (E)	0.39	0.08	0.39	0.08
Heating Fan/Pump (E)	0.53	0.15	0.53	0.15
Cooling (E)	0.98	0.73	0.98	0.73
Heating (E)	0	5.58	0	5.58
Heating (G)	17.78	0	17.78	0
Hot Water (E)	0.15	2.88	2.88	0.15
Hot Water, Suppl. (E)	0	0.56	0.56	0
Hot Water (G)	10.97	0	0	10.97
Lg. Appl. (G)	3.33	0	3.33	3.33
Total	58.5	35.9	50.82	45.36

* All-Electric Space and Water Heating Scenario's end uses were estimated from All-Electric Results. Future modeled results will be provided during the TAG process

	Site Energy Use (MMBtu/yr)			
Fuel	**Mixed-fuel Building**	**All-Electric Building**	**Heat Pump Water Heating**	**Heat Pump Space Heating**
Electricity	26.4	35.9	29.7	31.1
Natural gas	32.1	0.0	21.1	14.3
Total	58.5	35.9	50.8	45.4

	Site Energy Use			
Fuel	**Mixed-fuel Building**	**All-Electric Building**	**Heat Pump Water Heating**	**Heat Pump Space Heating**
Electricity (kWh)	7,743	10,524	8,707	9,103
Natural gas (therms)	321		211	143

	Utility Costs (Electricity Rate = $0.0856/kWh & Gas Rate = $0.818/therm)			
Fuel	**Mixed-fuel Building**	**All-Electric Building**	**Heat Pump Water Heating**	**Heat Pump Space Heating**
Electricity (kWh)	$ 662.80	$ 900.87	$ 745.33	$ 779.20
Natural gas (therms)	$ 262.48	$	$ 172.72	$ 117.00

Energy analysis completed by RMI

Equipment Lifetimes:

Equipment	Equipment Lifetime*
Heat Pump	18
Gas Fired Furnace	18
Central AC	18
Gas Water Heater	13
Heat Pump Water Heater	13
Cookstove	12

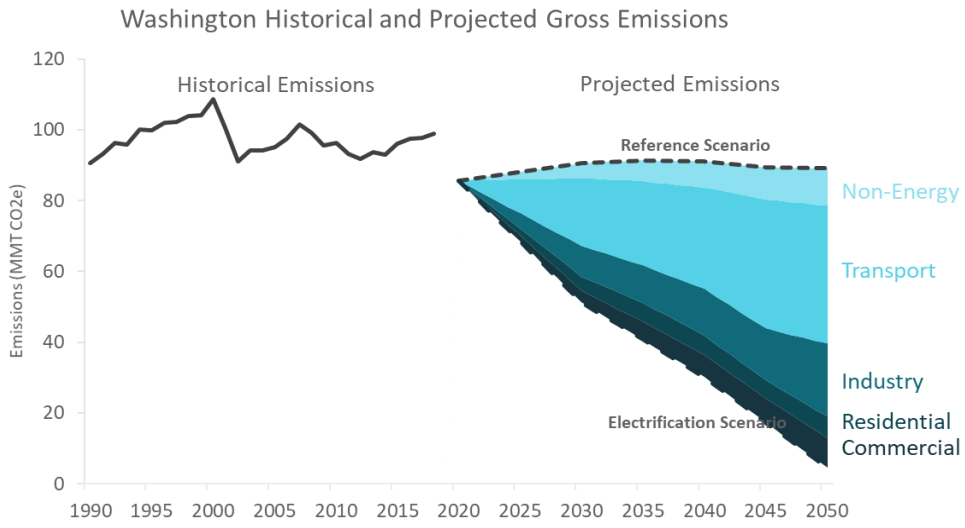
* https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/appendix-a.pdf

Total Gross Emissions: Reference vs Electrification Scenarios

WA SES EER DDP Modeling Final Report Page 26

		Emissions (MMT CO2e)
Year	Scenario	Residential
2020	Reference	11.4
2030	Reference	9.0
2035	Reference	9.0
2040	Reference	8.1
2045	Reference	6.9
2050	Reference	6.5
2020	Electrification	10.2
2030	Electrification	5.0
2035	Electrification	3.7
2040	Electrification	2.6
2045	Electrification	1.8
2050	Electrification	0.5

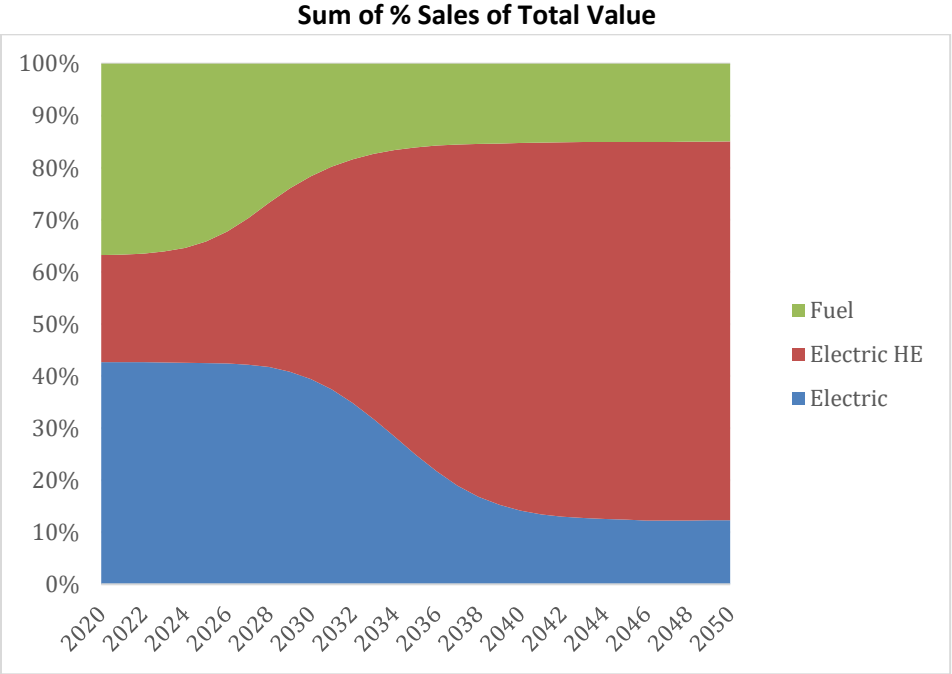
	% Reduction in Residential Building emissions required by target year in Electrification Scenario
2030	51%
2035	64%
2040	75%
2045	83%
2050	95%



Required % Sales of Residential Heat Pump Space Heaters to be Aligned with the Electrification Scenario

Subsector	residential space heating
Scenario	Electrification

Sum of % Sales of Total Value	Column Labels		
Row Labels	**Electric**	**Electric HE**	**Fuel**
2020	42.7%	20.6%	36.8%
2021	42.6%	20.7%	36.7%
2022	42.7%	20.9%	36.5%
2023	42.6%	21.3%	36.1%
2024	42.5%	22.1%	35.4%
2025	42.5%	23.3%	34.2%
2026	42.4%	25.3%	32.3%
2027	42.2%	28.1%	29.7%
2028	41.7%	31.5%	26.8%
2029	40.8%	35.2%	24.0%
2030	39.4%	38.9%	21.6%

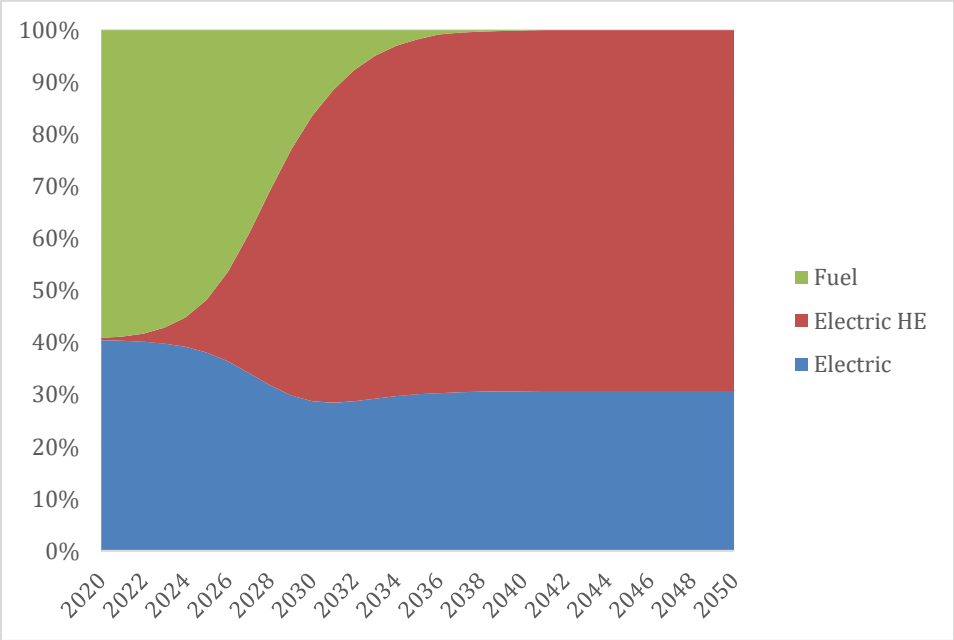


Required % Sales of Residential Heat Pump Water Heaters to be Aligned with the Electrification Scenario

Subsector	residential water heating
Scenario	Electrification

Sum of % Sales of Total Value	Column Labels		
Row Labels	**Electric**	**Electric HE**	**Fuel**
2020	40.5%	0.4%	59.1%
2021	40.4%	0.8%	58.8%
2022	40.2%	1.6%	58.3%
2023	39.8%	3.0%	57.2%
2024	39.2%	5.6%	55.2%
2025	38.1%	10.1%	51.8%
2026	36.4%	17.2%	46.4%
2027	34.2%	26.7%	39.1%
2028	31.8%	37.4%	30.8%
2029	29.9%	47.2%	23.0%
2030	28.7%	54.8%	16.5%

Growth from 2020 to 2030 = 130.2



Office of Financial Management
Olympia, Washington - Version: 2020-A
Life Cycle Cost Analysis Tool

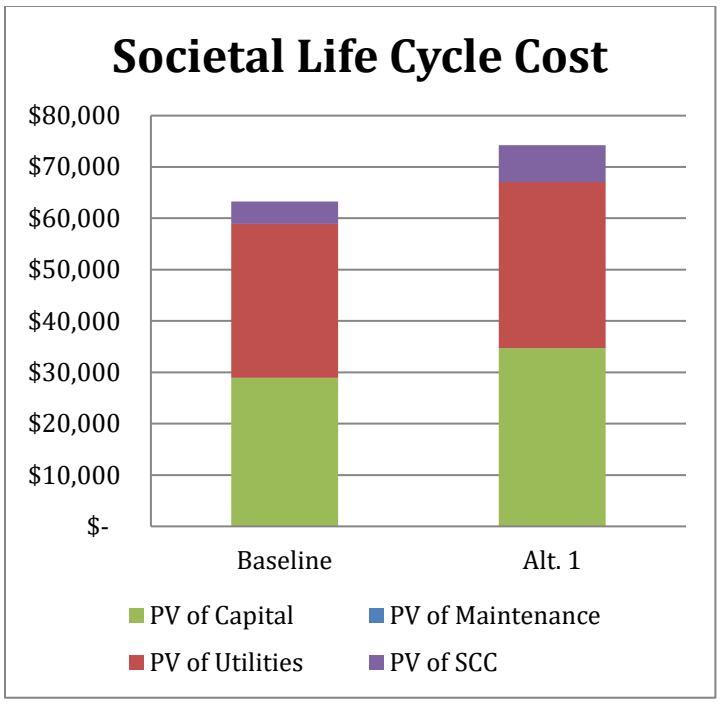
Executive Report

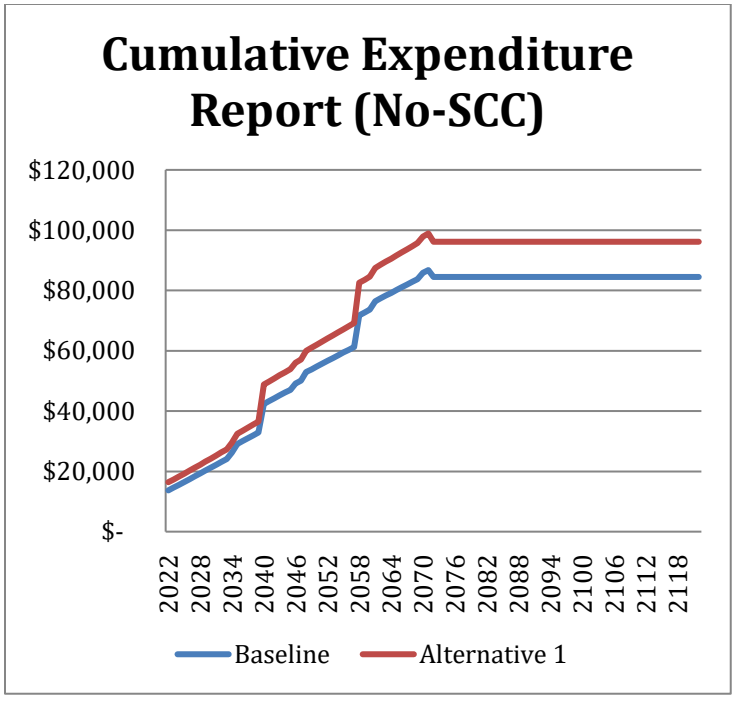
Project Information	
Project:	
Address:	N/A, N/A, N/A
Company:	RMI
Contact:	Jonny Kocher
Contact Phone:	
Contact Email:	jkocher@rmi.org

Key Analysis Variables		Building Characteristics
Study Period (years)	50	Gross (Sq.Ft)
Nominal Discount Rate	5.00%	Useable (Sq.Ft)
Maintenance Escalation	1.00%	Space Efficiency
Zero Year (Current Year)	2022	Project Phase
Construction Years	0	Building Type

Life Cycle Cost Analysis	BEST	
Alternative	Baseline	Alt. 1
Energy Use Intenstity (kBtu/sq.ft)	18.9	24.4
1st Construction Costs	$ 13,686	$ 16,411
PV of Capital Costs	$28,959	$ 34,752
PV of Maintenance Costs	$	$
PV of Utility Costs	$ 29,920	$ 32,319
Total Life Cycle Cost (LCC)	**$ 58,879**	**$ 67,071**
Net Present Savings (NPS)	**N/A**	**$ (8,192)**

(GHG) Social Life Cycle Cost	BEST	
GHG Impact from Utility Consumption	Baseline	Alt. 1
Tons of CO2e over Study Period	64	108
% CO2e Reduction vs. Baseline	N/A	-67%
Present Social Cost of Carbon (SCC)	$ 4,410	$ 7,191
Total LCC with SCC	**$ 63,288**	**$ 74,263**
NPS with SCC	**N/A**	**$ (10,974)**





Baseline Short Description
Heat Pump Space Heating Home
Alternative 1 Short Description
Mixed-Fuel Home

Link to full Life Cycle Cost Analysis Report